Supreme Court, U. S.
FILED
MAR 3 1978
MICHAEL RODAK, JR., CLERK

No. 77-642

In the Supreme Court of the United States

OCTOBER TERM, 1977

LUTRELLE F. PARKER, ACTING COMMISSIONER OF PATENTS AND TRADEMARKS, PETITIONER

v.

DALE R. FLOOK

ON WRIT OF CERTIORARI TO THE UNITED STATES COURT OF CUSTOMS AND PATENT APPEALS

BRIEF FOR THE PETITIONER

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OPINIONS BELOW

The opinion of the Court of Customs and Patent Appeals (Pet. App. A, 1a–5a) is reported at 559 F. 2d 21. The initial opinion and opinion on request for reconsideration of the Patent and Trademark Office Board of Appeals (Pet. App. B, 6a–10a, and Pet. App. C, 11a–13a) are unreported.

JURISDICTION

The decision of the Court of Customs and Patent Appeals was rendered on August 4, 1977. The peti-

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tion for a writ of certiorari was filed on November 2, 1977, and was granted on January 16, 1978. The jurisdiction of this Court rests on 28 U.S.C. 1256. *Gottschalk* v. *Benson*, 409 U.S. 63; *Dann* v. *Johnston*, 425 U.S. 219.

QUESTION PRESENTED

Whether a method is patentable subject matter under 35 U.S.C. 101 when the patent applicant's sole inventive contribution consists of a mathematical algorithm to be conventionally implemented, preferably in a standard general-purpose digital computer, and applied to control existing manufacturing processes.

CONSTITUTIONAL AND STATUTORY PROVISIONS INVOLVED

Article I, Section 8, clause 8, of the Constitution of the United States provides:

> The Congress shall have Power * * *
> * * * * * *
> To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries; * * *.

35 U.S.C. 101 provides:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof may obtain a patent therefor, subject to the conditions and requirements of this title.

STATEMENT

Respondent, an employee of Atlantic Richfield Company, applied for a patent on a "Method for Updating Alarm Limits" on manufacturing conditions that are monitored in the catalytic conversion of hydrocarbons (App. 3A, 15A, 16A).[1] In these commercial chemical processes, various "process variables" (such changeable conditions as heat, pressure, and reactant and product flow rates) must be maintained within specified ranges. Control systems are employed to monitor and regulate such process variables, and typically include general-purpose digital-computer equipment. These control systems periodically measure the values of the various process variables, compare these values to specified outer permissible limits, and alert an employee (usually through the sounding of an alarm) to take corrective action whenever the value of any of the process variables falls above or below those permissible limits (which are therefore called "alarm limits") (App. 3A–4A). Respondent's claimed invention provides a procedure for calculating the alarm-limit values, based on a mathematical algorithm.

In previous control systems, the alarm limits were calculated for each process variable and then fixed at

[1] Such hydrocarbon conversion processes commonly occur in industries such as petroleum refining and petrochemical processing. See, *e.g.*, App. 3A. Apparently, hydrocracking of petroleum distillates into gasoline is the most important application that respondent envisions. See App. 8A–10A, 63A–64A (claims 7, 8. 10).

the calculated values. For example, the alarm limit might be fixed at x units above or below the average expected value of the process variable. However, in normal catalytic chemical processing, where the values of at least some process variables can be expected to change, these values in some cases will approach or even exceed the originial alarm-limit values, as the process is carried out. To accommodate such changing conditions, the fixed alarm limits had to be periodically adjusted manually (App. 4A). In respondent's method, however, the alarm-limit values are periodically recomputed and "updated" to adjust for the expected changes in the values of process variables (App. 4A–5A).

Respondent's method accomplishes this periodic recomputation of the alarm-limit values by providing a mathematical formula or algorithm for calculating new ("updated") alarm-limit values based on prior values of the process variables.[2] For each process variable, the algorithm specifies that a pre-determined "alarm offset" constant be added to an "alarm base," which is a function of the present value of the process variable and all of its previously-measured values.[3]

[2] The algorithm is set forth in claim 1 of the patent application (App. 14A), and explained and illustrated in the specification (App. 5A–6A, 10A–13A). A detailed analysis of the equations that compose the algorithm is presented in the Appendix to this brief, *infra*, pp. 3A–6A.

[3] The alarm base is similar to an average, but one in which recent measurements are given more weight than earlier measurements. An example of an alarm base function would be the sum of the following: half of the present value of the process variable, plus one-fourth of the previously-measured value, plus one-eighth of the value measured before that, plus one-sixteenth of the value measured before that, and so on. See App., *infra*.

The sum of these numbers is the updated alarm-limit value for the process variable. As chemical processing continues, the algorithm is repeatedly carried out to calculate subsequent updated alarm-limit values. The dependence of the alarm-limit values on the present and previous values of the process variable allows expected changes in the process variable value to occur as the process continues without activating the alarm. In brief, respondent's method provides a formula that permits a control computer to recalculate alarm limits based on previous changes in the process variable.

Respondent's method does not specify the precise value of the alarm-offset constant or of the weighting factor that determines the relative weight to be accorded the present and past values of the process variable in calculating the alarm base function (App., *infra*). Rather, the user of the system must select the appropriate values for the constants to be employed in the formula. These values are determined empirically on the basis of the user's past experience with the process and process variable in question (App. 6A). Respondent states that the appropriate values can be arrived at by "routine experimentation" (*ibid.*). Similarly, the user must determine the frequency with which the process variables are to be measured and new alarm limits are to be calculated (*ibid.*).

Respondent claimed the general method (however implemented) for updating alarm-limit values on chemical hydrocarbon-conversion process variables by using this algorithm (see claim, App. 63A [4]), the

[4] Respondent's claim 1 breaks the method down into the following four steps: (1) measurement of the present value of the

method as implemented automatically (see claims 3–6, 9, and 10, App. 63A–64A), and, most specifically, the method as implemented electronically for hydro-cracking petroleum distillates (as in gasoline production) (see claim 10, App. 64A).[5] Under some claims (see claims 1, 2, 7, 8; App. 63A–64A), the method may be performed manually, with "'pencil and paper' calculations" (see App. 18A), but the application describes the use of electronic (*e.g.*, digital-computing) means as the preferred embodiment of the method (App. 7A).[6] In this embodiment, a conventional general-purpose digital computer that can be used to monitor a process (and generate a signal to set off an alarm when necessary) is programmed to perform respondent's algorithm, so that updated alarm-limit values are calculated according to the formula set forth in respondent's claim 1 (App. 41A–42A; App., *infra*.).

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process variable; (2) calculation of the "alarm base" value; (3) addition of the alarm-base value to the alarm-offset constant; and (4) adjustment of the alarm limit to reflect the newly-calculated value (App. 63A).

[5] The claims all depend on claim 1 but vary in different ways from it and one another by reason of greater specificity. Claim 6, for example, covers the method of claim 1 as implemented automatically to update values of alarm limits for at least 10 process variables, at least one of which is a "transient" (*i.e.*, changing) process variable. Claim 1 is the most sweeping and claim 10 is the narrowest and most specific.

[6] None of the claims, however, limits the method to performance by general purpose digital computers. Rather, the only claims containing limitations to electronic equipment (claims 9 and 10) specify only that the automatic operation of the method be accomplished "using electronic means" (App. 64A).

It is not disputed that, aside from the novel algorithm for computing updated alarm-limit values, every aspect of respondent's claimed invention is conventional and well-known in the art. Respondent stated that the chemical processes involved in catalytic conversion of hydrocarbons are "well-known," as are the operating conditions and catalyst compositions employed (App. 8A). He also stated that chemical process control systems already exist in which automatic equipment monitors the process variables and sets off an alarm if the acceptable limits on the variables are exceeded (App. 7A–8A, 12A, 21A–24A), and in which the user recomputes and readjusts these limits manually to conform them to changing operating conditions (App. 4A). Apparatus that can automatically carry out respondent's method—"automatic equipment involving a digital computer which can be used for automatic process monitoring-alarming" (App. 42A)—is "conventional and well-known" (App. 8A, 21A–24A, 30A–33A, 41A–45A). Automatic adjustment of alarm limits according to a programmed definition is conventional (App. 43A). Even the determination of the values of the constants used in respondent's updating method is made according to well-known principles regarding the normal behavior of the chemical process (App. 5A–6A, 8A).

The patent examiner found that "the only difference between [respondent's] claims and the prior art is in the mathematical formula involved in updating the value of an alarm limit" (App. 18A, 26A; see

App. 47A–48A). The computer programming of this mathematical formula for use in conventional electronic equipment is, respondent states, "well within the ordinary skill of the art" (App. 42A). Finally, as the examiner noted, such automation produced "no unexpected results" (App. 48A–49A). The patent examiner rejected all of respondent's claims as unpatentable under 35 U.S.C. 101 (App. 26A),[7] and stated that a patent on the claimed method "would in practical effect be a patent on the formula or mathematics itself" (App. 47A).

On appeal, the Board of Appeals of the Patent and Trademark Office (the "Board") sustained the rejection. Because respondent "proposes to use conventional automatic alarm adjusting equipment" to implement his claimed invention, the Board concluded, any inventive contribution that he made is only in "the formulas or algorithm [that he] disclosed and claimed" (Pet. App. B, 9a), and thus is unpatentable under the decision in *Gottschalk* v. *Benson*, 409 U.S. 63. Respondent requested reconsideration of the Board's decision, arguing that his claims are unlike Benson's. He contended that his claims do not cover a mathematical algorithm, because the final recited step of his method (step 4 of claim 1[8]) is not

[7] Initially, the examiner had also rejected respondent's claims to his method as implemented automatically (claims 3–6, 9, and 10) as insufficiently disclosed (35 U.S.C. 112). The examiner later withdrew this rejection (App. 34A–35A), however, and it was thus not in issue before the Board of Appeals or the court below, nor is it in issue now.

[8] See note 4, *supra*.

the solution of a mathematical equation, but rather the application of such a solution (made in the preceding steps) to a method of regulating a chemical process (App. 56A–58A). The Board rejected this attempted distinction as "specious" and reaffirmed its initial decision (Pet. App. C, 11a–13a).

The Court of Customs and Patent Appeals reversed, finding that respondent's claims "do not preempt the formula or algorithm contained therein, because solution of the algorithm, per se, would not infringe the claims" (Pet. App. A, 5a). The court ruled that the proscription on patentability in *Benson, supra,* is limited to situations in which the claims wholly pre-empt a mathematical formula or algorithm. The court therefore held that *Benson* did not govern this case, because the instant claims include a recitation that "materially limits [them] to a scope less than the mere act of solving an algorithm" (*id.* at 4a–5a).

SUMMARY OF ARGUMENT

Respondent seeks a process patent on a method for updating alarm limits on process variables involved in hydrocarbon conversions. The only advance over the prior art contained in respondent's method is the mathematical algorithm it utilizes. It is axiomatic that an abstract idea such as a mathematical formula is not itself patentable. Moreover, a process or method that incorporates a new abstract principle in a way that is conventional in light of existing technology is not patentable. Instead, to be patentable, embodiments of scientific or mathematical principles must be imple-

mented in an inventive manner. The rationale underlying this limitation on patentability is that the public has the right not only to the free exchange of abstract intellectual concepts, which are "the basic tools of scientific and technological work" (*Gottschalk* v. *Benson,* 409 U.S. 63, 67), but also to the benefits of the use of those concepts in ways that are entirely predictable. It is only the inventive use of a mathematical principle that warrants patent protection.

In *Benson,* this Court denied patent protection to a method that had no end-use limitations, noting that a patent "would wholly pre-empt the mathematical formula and in practical effect would be a patent on the algorithm itself." 409 U.S. at 72. Although respondent's claims extend only to the use of the algorithm in establishing alarm limits for process variables in hydrocarbon conversions, the method remains a set of mathematical equations to be used in arriving at a number; the fact that the number so derived has a particular practical application does not change the fact that the claimed invention is merely a way to calculate a number, so that, as in *Benson,* the issuance of the patent would in practical effect confer dominion over the equations themselves.

Because respondent's method contains nothing more than an algorithm applied in a conventional manner to existing technology, it is not patentable under 35 U.S.C. 101. Any extension of the scope of that Section is a matter for consideration by Congress, rather than the courts.

ARGUMENT

I. THE PATENT STATUTE AND THIS COURT'S DECISIONS INTERPRETING IT DO NOT PERMIT AWARD OF A MONOPOLY OF RESPONDENT'S CLAIMED METHOD

The patent statute (35 U.S.C. 101) permits a patent to be issued only to one who "invents or discovers" a new and useful advance that comes within one of four enumerated concrete classes of statutory subject matter: machines, articles of manufacture, composition of matter, and processes for making or using one of the foregoing.[9] Respondent claims a patent on a process—a new method for updating alarm limits on process variables involved in hydrocarbon conversion. Respondent's process is designed to be carried out in existing computers long in use, and to monitor conventional chemical processes in a manner virtually identical to that previously utilized. Only the particular mathematical steps that respondent utilizes are advances over the prior art (see, *e.g.,* App. 41A–45A).

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[9] The particular language involved here is quite old, dating from the original Patent Act of 1790, Section 1, 1 Stat. 109–110:

"That upon the petition of any person or persons * * * that he, she, or they, hath or have invented or discovered any useful art, manufacture, engine, machine, or device, or any improvement therein * * * it shall * * * be lawful to * * * cause letters patent to be made out * * *."

The term "process" was substituted for "art" in the 1952 Code; "process" is defined to mean "process, art, or method." 35 U.S.C. 100(b).

A. ABSTRACT IDEAS ARE NOT PATENTABLE

It is axiomatic that respondent's algorithm, consisting simply of mathematical formulae (App., *infra*), is not itself patentable. It is long settled that an abstract idea, even if it is an important advance in human thought, is not patentable. Thus patents will not issue for scientific principles, phenomena of nature, or mathematical formulae or algorithms. See, *e.g.*, *Gottschalk* v. *Benson,* 409 U.S. 63 (mathematical algorithm); *Funk Brothers Seed Co.* v. *Kalo Inoculant Co.,* 333 U.S. 127 (phenomenon of nature); *Rubber-Tip Pencil Co.* v. *Howard,* 20 Wall. 498, 507 (mechanical principle); *O'Reilly* v. *Morse* (the *Telegraph* case), 15 How. 62 (scientific principle).[10] Similarly, methods of doing business are unpatentable. *Joseph E. Seagram & Sons, Inc.* v. *Marzall,* 180 F. 2d 26, 28 (C.A. D.C.); *Hotel Security Checking Co.* v. *Lorraine Company,* 160 Fed. 467, 469 (C.A. 2).

These long-standing exclusions from statutory patent coverage stem from the constitutional limitation on Congress' authority to grant monopoly protection to only those "Discoveries" that "promote the Progress of Science and useful Arts" (Article I, Section 8, clause 8). See *Graham* v. *John Deere Co.,* 383 U.S. 1, 5–6. Issuance of patents on abstract ideas (however novel) would impede that progress more than advance it, because granting such monopolies would, as this Court stated in *Benson, supra.,* 409 U.S.

[10] See also *Le Roy* v. *Tatham,* 14 How. 156, 174–175; *Mackay Radio & Tel. Co.* v. *Radio Corp.,* 306 U.S. 86, 94; *Risdon Iron and Locomotive Works* v. *Medart,* 158 U.S. 68.

at 67, deny the public the benefit of "the basic tools of scientific and technological work."

B. USE OF AN ABSTRACT IDEA IS NOT PATENTABLE ABSENT INVENTION IN THE APPLICATION OF THE IDEA

Respondent does not contend that his algorithm is itself patentable; instead, he claims that his method "merely uses mathematical relationships in the intermediate steps of a claimed method to modify the operation of a hydrocarbon conversion process" (Br. in Opp. 4). But for the same reasons that abstract ideas, "the basic tools of scientific and technological work" (*Benson, supra,* 409 U.S. at 67), are not patentable, the use of such ideas (or formulae) in conventional ways to solve practical problems is not patentable. An unpatentable abstract idea does not become patentable simply because it is incorporated into a process that is useful, but entirely predictable in light of the prior art.

This limitation is reflected in this Court's precedents and 35 U.S.C. ~~1001~~ 101, codifying them.[11]

[11] As this Court implicitly recognized in *Benson, supra,* by its reliance on early cases, enactment of the 1952 Patent Code did not change the prior law. See *Aro Manufacturing Co.* v. *Convertible Top Co.,* 365 U.S. 336, 347 n. 2 (Black, J., concurring) (noting that, immediately before the vote in the Senate, the Chairman of the Judiciary Committee stated, in response to the question whether "the bill change[s] the law in any way or only codif[ies] the present patent laws," that the bill "codifies the present patent laws"). As noted *supra* at n. 9, Congress has not altered the statutory language requiring "invention or discovery" in the section enumerating the classes of patentable subject matter since the inception of the patent system. Nor did the addition of 35 U.S.C. 103, defining and codifying the standard for "non-obvious

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Section 101 requires that a patent applicant "invent or discover [a] * * * process * * * or * * * improvement thereof" to be entitled to a patent for a claimed development. Under this standard, it is not enough that a process be newly "discovered" in the broadest ordinary sense of the term. Rather, the patent law requires that a patentable discovery be of the kind that warrants the imposition of a monopoly grant. Respondent's process is not a discovery of that kind because the mathematical algorithm, the sole arguably inventive feature,[12] is neither concretely embodied by means of a specifically devised apparatus, nor otherwise applied in a novel and inventive manner to the specific use claimed.

1. Concrete embodiment in a specifically devised apparatus

In *Gottschalk* v. *Benson, supra,* reviewing "the requirements of our prior precedents" on the patent-

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subject matter," change the existing body of law denying patentability for abstract ideas. Section 103 was enacted to codify the law regarding the degree of advance over prior art that would justify a monopoly grant, not to deal with the patentability of ideas or abstractions or of processes incorporating them.

In any event, since the Board concluded that respondent's claims did not contain patentable subject matter as defined in Section 101, it did not reach the question whether the process was barred from patentability by Section 103. Therefore, the question whether the claim embodied a sufficient advance over the prior art to merit a patent was not before the court below and is not before this Court. Cf. *Dann* v. *Johnston*, 425 U.S. 219.

[12] The examiner evidently concluded that respondent's mathematical formulae were novel (App. 26A, 48A–49A). We do not contest this conclusion.

ability of methods (409 U.S. at 67–71), this Court found that patents for processes applying scientific principles or ideas have been upheld only when: (1) the process was carried out with a specific apparatus devised to implement the newly-discovered idea, and (2) the claim to a monopoly was confined to a specific end-use or field of art or technology.[13] The method that Benson sought to patent was a mathematical algorithm for changing binary-coded decimal ("BCD") information into pure binary information. This was presumably a meritorious and novel idea, useful in the Bell Company's telephone switchboard systems as well as in many other applications. But Benson's claims did not meet either of the two requirements of patentability for such methods: the claims were limited neither (1) to any category of application that was narrower than the whole field of performing BCD-to-binary conversion in the course of "data processing," nor (2) to use in any specific new machinery devised to practice Benson's method or to any more specific old machinery than general-purpose digital computers. In effect, Benson's claimed invention

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[13] The Court considered such apparatus and end-use limitations essential to placing reasonable boundaries on the scope of the monopoly grant. In so ruling the Court found that in cases such as that involving a process for converting fats into glycerine, specificity as to ingredients, temperatures, and pressures supplied the requisite boundaries to the monopoly granted (409 U.S. at 69–70). Such cases are not pertinent to *Benson* or the present case, in which the claimed methods are not particular methods for accomplishing specific physical transformations of one substance into another.

was a method consisting of a new series of mathematical steps to accomplish BCD-to-binary conversion, by means of a conventional general-purpose digital computer.

The Court suggested that "the requirements of our prior precedents" indicate that "a process patent must either be tied to a particular machine or apparatus or must operate to change articles or materials to a 'different state or thing' " (409 U.S. at 71).[14] It found it unnecessary to rely on this rule in order to decide the case before it, in light of the conceded principle that ideas themselves are not patentable. Issuance of the patent in *Benson* was accordingly improper because it would "wholly pre-empt the mathematical formula and in practical effect would be a patent on the algorithm itself" (409 U.S. at 72).

Respondent's claimed invention falls squarely within the rule of *Benson*. Respondent's method does

[14] The court noted (409 U.S. at 68–69) that its earlier cases emphasize the importance of the embodiment of the mathematical or abstract idea in a specific apparatus. Thus, in *O'Reilly* v. *Morse* (the *Telegraph* case), 15 How. 62, the Court allowed Morse's claim for a process using the principle of electromagnetism for communicating information by means of a specified novel apparatus Morse had devised to produce signals for telegraphic use. But the Court denied Morse's broader claim for the general method of communicating by means of electromagnetism, because that would impermissibly extend Morse's patent monopoly to cover a whole scientific principle, regardless of the apparatus utilized to carry out the method and scientific principle. In *The Telephone Cases*, 126 U.S. 1, the Court allowed Bell's method claim for telephonic use of electric current, only because it was limited to the method as carried out with the "magneto and variable resistance" (*id.* at 538) mouth-piece devices that Bell had developed.

nothing more than provide a different mathematical procedure for calculating limiting values on variables to be used in chemical processing, just as Benson's method provided a different mathematical procedure for calculating the pure binary equivalents of BCD numbers to be used in data processing. Neither method involves specific apparatus newly devised to implement the mathematical procedure. Rather, respondent's method, like Benson's, involves computing apparatus that is old in the art: respondent expressly admitted (*e.g.*, App. 41A–45A) that the mathematical algorithm can be, and indeed is designed to be, "carried out in existing computers long in use" for monitoring and regulating chemical processes (cf. *Benson, supra,* 409 U.S. at 67).[15] Only the particular mathematical steps that respondent utilizes are advances over the prior art.

To be sure, respondent's method is more limited than Benson's to a specific end-use, art, or technology,

[15] Indeed, some of respondent's claims are so broad that they need not be performed by electronic digital-computer means; rather, they can be performed manually (as the examiner found, App. 18A), or on a hand-held pocket calculator. Anyone using the mathematical concepts of respondent's algorithm to calculate alarm-limit values for these chemical process variables (and then using the numbers for "updating") would infringe respondent's claim 1, regardless of the means by which the calculation is made.

Moreover, claim 1 is not even a method of making or using a machine, article of manufacture, or composition of matter. It is simply a method of calculating a number (termed an "alarm limit"). Similar objections apply to at least claims 2, 7, and 8. Methods of calculating numbers, regardless of what the numbers are then used for, are not patentable. *Gottschalk* v. *Benson*, *supra*.

since respondent limits his claims to use in calculating alarm-limit values "involved in" hydrocarbon conversion (claim 1, App. 63A). But respondent's method remains a method of solving mathematical equations to arrive at a number; the fact that it may have a practical application in controlling chemical processing (or in other ways that respondent chose not to claim) does not change the fact that the claimed invention is merely a way to calculate a number. In our view, for example, the result would have been the same in *Benson* had the claim there been limited to use in conventional telephone switchboard systems. See note 14, *supra* (discussing the *Telephone* and *Telegraph* cases).

The court below was accordingly incorrect in distinguishing *Benson* on the ground that the claims here do not *wholly* pre-empt the mathematical equation, because the calculated numbers are used to 'update' alarm limits, which in turn can be used to monitor conditions in conventional manufacturing systems. Based on this alleged distinction, the court held that "solution of the algorithm, *per se,* would not infringe the claims" (Pet. App. A, 5a).[16] But such a distinction is, as the Board below held, "specious" (Pet. App. C, 12a). Respondent's recitation of a last step that conventionally applies the result of a set of steps describing a mathematical calculation adds nothing that makes the algorithm a patentable invention. It is as if respon-

[16] The claims literally cover both (1) the algorithm used to calculate alarm-limit values and (2) the adjustment of the alarm limits to reflect the newly calculated values (see note 4, *supra.*)

dent were trying to patent the Pythagorean Theorem as part of a method, by adding a final step that suggested applying the solution of the equation to surveying. Such a last step is not an integral part of a new invention, but rather the non-inventive application of a mathematical result to existing technology;" that fact is not changed by the facile device of so drafting a claim that it places an abstract mathematical algorithm within or before a recitation of steps conventionally performed in existing technology. Cf. *Application of Christensen,* 478 F. 2d 1392 (C.C.P.A.).

2. Novel and inventive use

Even if the end-use limitations in respondent's claims were sufficient to distinguish his application from the one involved in *Benson,* he would still not be entitled to a patent under Section 101. To merit monopoly protection, it is not sufficient that a claim embody a concrete, tangible application of a mathematical or scientific principle; it must also extend beyond the routine, conventional, or uninventive applications that follow once the applicant possesses the idea. Thus in *Funk Brothers Seed Co.* v. *Kalo Inoculant Co.,* 333 U.S. 127, the patentee had discovered the law of nature that particular strains of bacteria used to inoculate certain plants did not have an inhibitory effect on one another.[18] He then applied this discovery

[17] It is undisputed that the use of calculated alarm-limit values to monitor chemical process variables is old in the art. See *supra* at p. 7.

[18] The patentee "discovered" the law in the sense that he was first to recognize and utilize it.

by preparing a new mixture of bacteria culture. Despite the fact that this new mixture was a concrete product, newly devised to be employed for a specific end-use in a specific art or technology, the Court held that it nevertheless "fell short of invention within the meaning of the patent statutes" (*id.* at 131). The reason, as the Court explained, was that there was nothing inventive in preparing the mixture of bacteria to carry out the discovery, once the scientific discovery (unpatentable in itself) was grasped—"however ingenious the discovery * * * may have been, the application of it is hardly more than an advance in the packaging of the inoculants" (*ibid.*). In *Benson, supra,* 409 U.S. at 67–68, the Court held that the principle of *Funk* applies to process claims (like those at issue in both *Benson* and the present case) as well as to claims for "products" (involved in *Funk*).

Similarly, in an analogous chemical processing case, *Davison Chemical Corp.* v. *Joliet Chemicals, Inc.,* 179 F. 2d 793 (C.A. 7), certiorari denied, 340 U.S. 816, the patent applicant had "discovered" that the higher the temperature of the wash water used in the process for manufacturing silica gel, the lower the density of the final product. The court found that this principle was new, but that its application to the old process of silica gel manufacturing was not an invention warranting a patent monopoly, stating (*id.* at 795): "Discovery of a previously unknown law of operation, involved in no new method, has never been held to be

invention. The application of the law must be novel and inventive in character." [19]

Thus, regardless of the novelty of the basic scientific or mathematical principle, its application must also be inventive for the method or product to qualify for a patent grant.[20] Unless that test of inventiveness

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[19] See, to the same effect as *Funk* and *Davison*: *Armour Pharmaceutical Co.* v. *Richardson-Merrell, Inc.*, 396 F. 2d 70, 73–74 (C.A. 3); *National Lead Co.* v. *Western Lead Products Co.*, 324 F. 2d 539, 542 (C.A. 9); *Loew's Drive-In Theatres, Inc.* v. *Park-In Theatres, Inc.*, 174 F. 2d 547, 551–552 (C.A.), certiorari denied, 338 U.S. 822; *Templeton Patents, Ltd.* v. *J. R. Simplot Co.*, 336 F. 2d 261 (C.A. 9). In each of these cases the courts held that no patent should have been granted, because there was no invention in devising the claimed embodiment once the patentee had possession of the idea (which was unpatentable as such). See also *Rubber-Tip Pencil Co.* v. *Howard*, 20 Wall. 498, 507 (once patentee had idea of attaching eraser head to pencil, device to give idea effect involved nothing "new").

Respondent suggests (Br. in Opp. 5) that *Application of Bernhart*, 417 F. 2d 1395 (C.C.P.A.), holds that it is inappropriate to evaluate a claimed invention by determining whether its single element of novelty is patentable. But the principle enunciated by the court below in *Bernhart* is inconsistent with *Application of Christensen*, 478 F. 2d 1392, 1393 (C.C.P.A.), and with this Court's decision in *Funk* and the courts of appeals cases cited above.

[20] Similarly, claimed new combinations of old elements are patentable only if they are inventive, in the sense that the old elements must co-operate or co-act with one another in such a way that "the whole in some way exceeds the sum of its parts." *Great Atlantic and Pacific Tea Co.* v. *Supermarket Equipment Corp.*, 340 U.S. 147, 152. See also *Lincoln Engineering Co.* v. *Stewart-Warner Corp.*, 303 U.S. 545, 549; *Reckendorfer* v. *Faber*, 92 U.S. 347, 356–358; *Anderson's-Black Rock, Inc.* v. *Pavement Salvage Co.*, 396 U.S. 57, 61; *Deepsouth Packing Co.* v. *Laitram Corp.*, 406 U.S. 518, 521–522; *Sakraida* v. *Ag Pro, Inc.*, 425 U.S. 273, 282. No such claim is, or could be, made for respondent's claimed invention.

is continued, the public will be deprived of its right freely to utilize the ordinary applications that follow from abstract ideas and laws of nature.[21]

Respondent's application of the algorithm for determining alarm limits does not meet this test of inventiveness. The only inventive contribution in respondents's method is in the mathematical formula by which alarm-limit values are calculated. Once respondent worked out the equations or algorithm for computing the values, each aspect of the implementation of this algorithm was entirely straightforward and conventional—just as the aggregation of certain bacteria in *Funk, supra,* and the increase of the wash water temperature for making silica gel in *Davison, supra,* were straightforward and conventional implementations of the scientific principles involved in those cases.

Indeed, as the patent examiner stated, respondent's application of his idea contained "nothing new over the prior art [except] the formula or mathematics"

[21] Thomas Jefferson recognized a similar need to draw "a line between the things that are worth to the public the embarrassment of an exclusive patent, and those which are not" in his famous letter to Isaac McPherson, August 13, 1813, quoted in part in *Graham* v. *John Deere Co.*, 383 U.S. 1, 8–9 n. 2. Jefferson noted that the original patent board had developed the general rule that "* * * a machine of which we were possessed, might be applied by every man to any use of which it is susceptible, and that this right ought not to be taken from him and given to a monopolist, because the first perhaps had occasion so to apply it. Thus a screw for crushing plaster might be employed for crushing corncobs. And a chain-pump for raising water might be used for raising wheat: this being merely a change of application." VI *Writings of Thomas Jefferson* 182–184 (Washington ed.).

(App. 48A), and respondent's implementation of the idea by use of automatic computer equipment produced "no unexpected results" (App. 48A–49A). It follows, therefore, that however ingenious respondent's discovery of the mathematical equations may have been, its routine application by conventional means here "fell short of invention within the meaning of the patent statues" (*Funk, supra.* 333 U.S. at 131).

Since respondent's method involves neither a newly devised apparatus nor any other inventive manner of implementing an idea, there exists nothing to raise the innovative mathematical algorithm from the unpatentable status of an idea to the patentable status of an "invent[ion] * * * [of a] new and useful process" under 35 U.S.C. 101.

II. THIS COURT SHOULD NOT MODIFY ESTABLISHED PRINCIPLES GOVERNING PATENTABILITY

For the reasons noted above, the decision of the court below is inconsistent with well-settled judicial interpretation of the patent statute, which has existed in substantially the same form since its first enactment in 1790.[22] As this Court recognized in *Benson, supra,* 409 U.S. at 72–73, changing the standards of patentability to permit the patenting of computer applications of mathematical algorithms would raise serious problems "which only committees of Congress can manage, for broad powers of investigation are needed, including hearings which canvass the wide

[22] See note 9, *supra.*

variety of views which those operating in this field entertain".[23]

In any event, we submit that no such change is desirable. The public policy considerations underlying the present standard of patentability require that no patent monopoly be granted if its effect would be to withdraw the basic currency of technological and scientific progress from the public domain. See *Benson, supra,* 409 U.S. at 67.

Should the judgment below be upheld, substantial numbers of patents for noninventive computer applications of abstract ideas, mathematical in nature or otherwise, will issue.[24] This would have a debilitating effect on development of the computer industry [25] and

[23] This is particularly so since developing a system for effective review of such claims would impose a substantial additional burden on the Patent Office. If Congress determines that the Patent and Trademark Office should assume these responsibilities, it can provide the necessary resources.

[24] The Patent and Trademark Office estimates that approximately 600 to 900 applications for computer programming patents are now pending, and that approximately 450 such applications are now filed each year.

[25] The 1972 receipts volume for computer programming and other software services, defined as "establishments primarily engaged in providing services in computer programming, systems design and analysis, and other computer 'software'" (*Standard Industrial Classification Manual* (1972)), was almost $1 billion, out of a total data-processing services volume of $3.4 billion. United States Department of Commerce, *U.S. Service Industries in World Markets: Current Problems and Future Policy Development* A–96 (December 1976). This nearly $1 billion figure is exclu-

on all areas of the economy (of which chemical processing is only one example) in which computer technology can be applied.[26] The considerable added burden of time-consuming and expensive patent litigation in the courts would result in an additional social cost of any such revision of the basic standards of patentability. It is for Congress, rather than the courts, to determine whether additional protection for creative activity, beyond that afforded by the present patent laws, is desirable in this rapidly developing field and, if so, the form that protection should take.[27]

sive of the software services that integrated electronic computer manufacturers provide in conjunction with their computer systems. Compare *Standard Industrial Codes* 3573 ("Electronic Computing Equipment") and 7372 ("Computer Programming and Other Software Services") (1972). The estimated 1976 dollar volume for the software services industry was more than $1.7 billion. International Data Corporation, *1977 Annual Report: The Computer Services Industry* 9 (1977).

[26] One example of such a debilitating effect is that in order to avoid the "often staggering" expenses of defending a patent suit (see *Picard* v. *United Aircraft Corp.*, 128 F. 2d 632, 641 (C.A. 2) (concurring opinion of Frank, J.)) businessmen may pay tribute to specious patents of this type on the ground that royalty payments are a lesser evil than litigation expenses. See generally *Blonder-Tongue Laboratories, Inc.* v. *University of Illinois Foundation*, 402 U.S. 313, 334–336.

[27] A Commission to study changes in the copyright laws relating to computer programs was established by Pub. L. 93–573, Section 201, 88 Stat. 1873 (1974) (17 U.S.C. (Supp. V) 201 note). The Commission is to submit its final report by July 31, 1978. Pub. L. 95–146, 91 Stat. 1226 (1977).

CONCLUSION

For the foregoing reasons, the judgment of the Court of Customs and Patent Appeals should be reversed.

Respectfully submitted.

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MARCH 1978.

APPENDIX

ANALYSIS OF RESPONDENT'S FORMULA

A chemical process such as hydrocarbon conversion involves various "process variables" (such as temperature) that may change as the process is performed.[1] For example, while it may be normal or even desirable for such a variable to increase slowly over time, too great or rapid an increase might jeopardize the successful completion of the process. As respondent stated in his specification (App. 3A–4A), in present control systems an "alarm limit" is therefore set for each process variable, which regulates the process by alerting the system operator (sounding an alarm) if the value of the process variable exceeds its specified limiting value. As represented in Figure 1, the alarm is set off if the value of the process variable (*"PVL"*) reaches the alarm-limit value (*"AV"*):

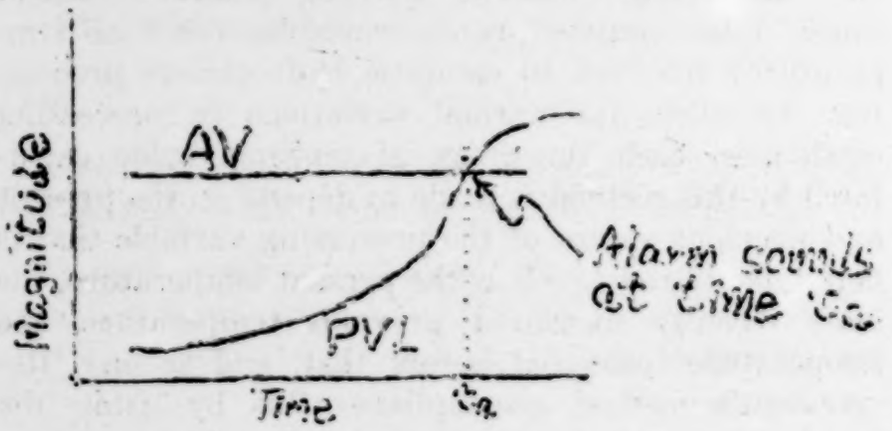

FIG. 1

[1] See *supra*, at p. 4.

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An alarm limit that is fixed at one value for the duration of the process is of limited utility, however, because regulation of a sensitive process may require that a process variable not exceed one value at one stage of the process, and another value at another stage (as in Figure 2); or that the value of a process variable increase at a particular rate (as in Figure 3):

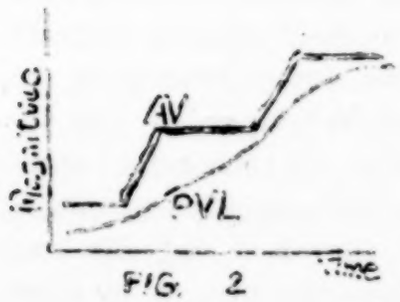


FIG. 2

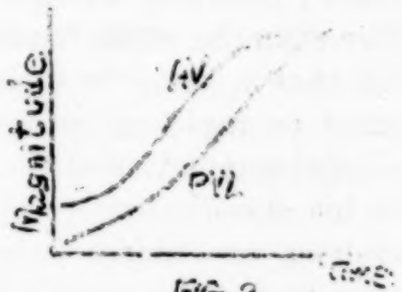


FIG. 3

Effective process regulation may require that such relationships be established between the alarm-limit values and the previous and present values of the process variable. Respondent seeks a patent on a method for calculating updated limiting values ("alarm limits") to regulate process variables (such as temperature) involved in catalytic hydrocarbon processing. To allow for normal variations in processing conditions, each successive alarm-limit value calculated by this method is made to depend on the present and previous values of the processing variable that is being monitored (such as the present temperature, the most recently measured previous temperature, the temperature measured before that, and so on). Respondent's method accomplishes this by using the basic mathematical concept of defining the new ("updated") alarm-limit value as a function of the past and present values of the process variable, and then periodically computing the function by "plugging in"

the newly measured values of the process variable. Such a function is known as a "smoothing function"; it is a kind of "average" that gives relatively greater weight to the more recent values of the process variable than to the earlier values.[2]

Respondent's method uses the following equations to arrive at an updated alarm-limit value (*"UAV"*) for a process variable (see App. 5A):

(Eq. 1) $$B_0 = CAV - K,$$

where CAV is the current value of the alarm limit, K is an empirically-determined alarm offset constant, and B_0 is the 'alarm base' (a function of initial and subsequent values of the process variable);

(Eq. 2) $$B_1 = (B_0)(1-F) + (PVL)(F),$$

where PVL is the present value of the process variable, F is an empirically-determined constant or weight factor greater than 0 and less than 1, B_0 is the prior value of the 'alarm base' (from the previous equation), and B_1 is the recalculated value of the 'alarm base'; and

(Eq. 3) $$UAV = B_1 + K,$$

where UAV is the updated value of the alarm limit, and K and B_1 are from equations (1) and (2).

As each successive updated value (UAV) is determined, it is substituted for the last alarm-limit value (CAV) in order to monitor the process variables (see App. 11A).

The updated alarm-limit value is thus defined to be a constant value ("K") greater than the value of

[2] See R. Brown, *Smoothing, Forecasting and Prediction of Discrete Time Series* (1963) (hereafter "Brown"), at 101–104.

the alarm-base B_1 (equation 3).[3] This alarm-base value is in turn calculated according to a smoothing function of the present and previous values of the process variable ("*PVL*") in question. The effect of utilizing this smoothing function can best be illustrated by carrying out a sample calculation, taken from the patent application.

In Example 1 in respondent's specification (App. 10A–12A), the process variable that is being monitored is the temperature of the reactor bed of catalyst, and the alarm-offset constant ("*K*") and alarm-base weighting factor ("*F*") have been set at +9° and 0.6, respectively. At the beginning of the process, the reactor bed temperature is 432°. The first value of B_0 therefore is also 432°, since it is defined as the initial value of the process variable. After the first time interval [4] elapses, the reactor bed temperature has increased to 436°. The first recalculated value of the alarm-base function B_1 is thus the weighted sum of 60 percent of the present temperature and 40 percent of the past temperature (with the 60–40 weighting being determined by the weighting factor *F*). It is calculated (according to Equation 2) as follows:

(Eq. 2) $B_1=(B_0)(1-F)+(PVL)(F)$

(Eq. 4) $B_1=(432)(0.4)+(436)(0.6)$
$=434.4.$

Substituting this value for B_1 in Equation 3 gives the first alarm-limit value *UAV*:

(Eq. 5) $UAV=434.4+9=443.4.$

[3] If *K* is a negative number, the value of *UAV* will be a constant value less than the alarm base function B_1. In other words, when *K* is negative, a lower (rather than an upper) limiting value is calculated.

[4] In respondent's Example 1, measurements and calculations are made every ten minutes (App. 11A).

After ten more minutes have elapsed, the temperature has increased to 440.5. Thus the new B_1 (the recalculated value of the alarm base after the second measurement) is calculated as follows (again, according to Equation 2):

(Eq. 6) $B_1=(434.4)(0.4)+(440.5)(0.6)=438.1,$

and the updated alarm-limit value (again, according to Equation 3) is:

(Eq. 7) $UAV=438.1+9=447.1.$

Thus the new alarm-base value B_1 is a weighted sum of 60 percent of the present temperature and 40 percent of the function of the two previous temperatures that was calculated in Equation 4, above.

At the third time interval, the temperature was measured at 444.5°. Carrying out the algorithm again produces the following result:

(Eq. 8) $B_1=(438.1)(0.4)+(444.5)(0.6)=441.9.$
(Eq. 9) $UAV=441.9+9=450.9.$

At the fourth time interval, the temperature was measured at 448°. The updated values of B_1 and *UAV* are again calculated according to equations 2 and 3, respectively:

(Eq. 10) $B_1=(441.9)(0.4)+(448)(0.6)=445.6.$
(Eq. 11) $UAV=445.6+9=454.6.$

As can be seen by comparing Equations 10, 8, 6, and 4, in each successive calculation of the alarm-base function the most recent measured value of the process variable is the most heavily weighted, while all the previous values of the process variable are "lumped together" in one term, so that each preceding one is

weighted less heavily. If the most recent value of the process variable is designated as PVL_1, and the next most recent value as PVL_2, etc., equation 10 may be rewritten and extrapolated as follows:

(Eq. 12) $B_1=(0.6)(PVL_1)+(0.4)[(0.6)(PVL_2)+(0.4)\{(0.6)(PVL_3)+(0.4)[(PVL_4)(0.6)+\ldots]\}]$

Collecting the terms,

(Eq. 13) $B_1=(0.6)(1)(PVL_1)+(0.6)(0.4)(PVL_2)+(0.6)(0.4^2)(PVL_3)+(0.6)(0.4^3)(PVL_4)+\ldots$

Thus,

(Eq. 14) $B_1=(0.6)(PVL_1)+(0.24)(PVL_2)+(0.096)(PVL_3)+(0.0384)(PVL_4)+\ldots$

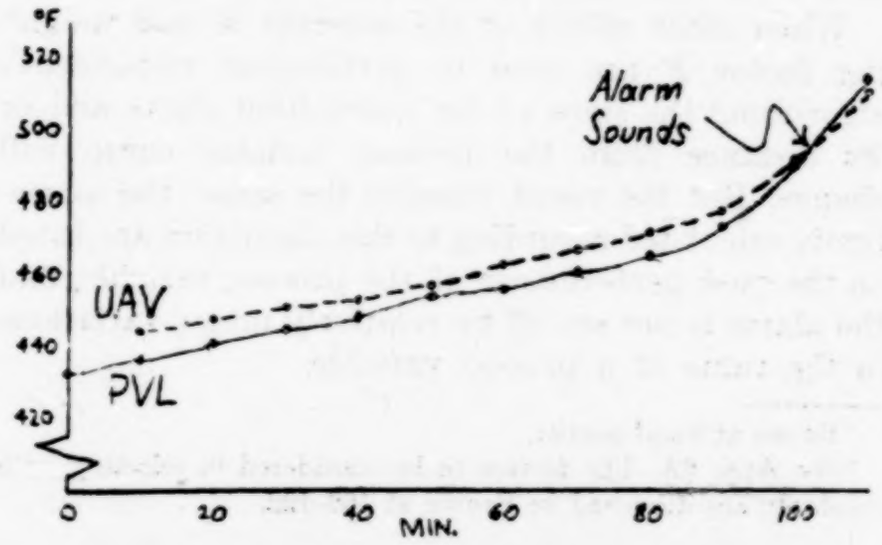
Equations 12–14 show the actual weight that each previous value of the process variable is given in this calculation of the alarm-base. It is readily seen that the more recent values are weighted more heavily than older values, in accordance with a geometric proportion.[5] The final updated alarm value is, of course, simply the sum of a constant number and this alarm-base value.

[5] The alarm-base function may be generalized substantially as follows, an expression in which B_t=the latest (or current) value of the alarm-base function:

(Eq. 15) $$B_t=(F)\sum_{i=0}^{t}(PVL)_{t-i}(1-F)^i$$

See Brown at 101 (deriving a similar expression). Brown explains that such exponential smoothing calculations "produce an average in which past observations are geometrically discounted according to their age" (*id.* at 106).

The values of the reactor bed temperature ("*PVL*") and the corresponding updated alarm-limit values ("*UAV*") for the first twelve temperature measurements in this example are plotted as curves in Figure 4:[6]



It can be seen from Figure 4 that the curve of the alarm limits calculated according to respondent's algorithm reflects the general shape of the curve of the process variable. Only at the point at which the process variable value increases "too suddenly" (between 100 and 110 minutes, from 490° to 515°) does the corresponding alarm-limit value fail to rise fast enough to reflect the temperature curve; it is at this point that the measured temperature exceeds the alarm limit (and, presumably, the alarm is set off). The curve of the constantly recalculated alarm limits is, in effect, a "smoothed-out" version of the curve of the measured temperatures, allowing the temperature to vary as long as it remains less than the alarm limit.

[6] Figure 4 is taken from the chart illustrating Example 1 of respondent's specification (App. 12A).

Such smoothing functions are commonly used in business and manufacturing applications to correct for variation in the predicted performance of the variables that are being observed or controlled, such as speed, temperature, amount of inventory in stock, orbits for satellites, missile positions, rainfall, etc.[7]

When other values of the constant K and weighting factor F are used in performing respondent's algorithm,[8] the slope of the alarm-limit curve and/or its distance from the process variable curve will change. But the result remains the same: the alarm-limits calculated according to this algorithm are based on the past performance of the process variable, and the alarm is not set off by relatively minor variations in the value of a process variable.

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[7] Brown at 9 and *passim*.

[8] See App. 6A. The factors to be considered in selecting such constants are discussed in Brown at 106–122.

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